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(54) **Method for arranging compressed video data for transmission over a noisy communication channel**

Verfahren zum Arrangieren komprimierter Videodaten zur Übertragung über einen verrauschten Kanal

Procédé d'agencement de données video comprimées pour la transmission sur une voie de communication bruyante

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Description

[0001] The present invention relates to a method and apparatus for segmenting compressed video data into cells or packets for transmission in a manner to allow a receiver to rapidly recover from occurrences of missing data or corrupted data.

[0002] The Moving Picture Experts Group (MPEG) are establishing a standard for transmission and storage of video data primarily for use by computers. This proposed standard is detailed in the document "International Organization for Standardization", ISO-IEC JT(1/SC2/WG1), Coding of Moving Pictures and Associated Audio, MPEG 90/176 Rev. 2, Dec. 18, 1990. The signal protocol is hierarchical or layered. Frames of video data are compressed in groups of, for example, 15 frames. Respective frames are either intraframe encoded (I frames), forward predictive interframe encoded (P frames) or forward/backward predictive interframe encoded (B frames). Each frame is divided into slices corresponding to horizontal image bands (e.g., 16 line stripes). The slices are segmented into macroblocks consisting of matrices of 16 by 16 pixels. The macroblocks are encoded in four 8 by 8 blocks of luminance values, and two 8 by 8 blocks of chrominance values (U and V signal components). Each of the 8 by 8 chrominance blocks are derived by horizontally and vertically subsampling component chrominance values representing respective 16 by 16 macroblocks. The signal protocol calls for a sequence layer for identifying the overall signal type, which layer includes a sequence start code and header information identifying, for example, picture size, pixel aspect ratio, picture rate, bit rate, buffer size, a number of flag bits, etc. Following the sequence layer is a group of pictures, GOP header which include a start code, a time code, a closed GOP flag, a broken link flag and extension data. The next layer includes a picture start code and picture header. The picture (PICT) header includes a temporal reference, picture coding type (I, P, B), buffer fullness, vector and pixel precision flags, variable length code identifiers and extension data. A slice start code follows the picture layer and includes a start code and a header identifying the slice. Following the slice layer is the macroblock layer which includes a start code and header data. The macroblock header data includes identifying indicia, quantizing information, type of encoding etc. The macroblock layer also includes motion vectors which are common to the six blocks of data in each macroblock, and encoded block data on a block by block basis. The compression algorithm involves predicting frames of video signal from prior frames of video signal and transmitting in compressed form, the differences between actual and predicted frames. Successively encoded frames are dependent on the correctness of prior encoded frames. Only one or a small number of frames in a group of pictures is non predictively encoded. It should be immediately recognized that, in a receiver, decoding errors due to data loss or corruption during transmission will propagate through successive frames within a GOP. In order to preclude the propagation of such errors and concomitant image corruption special precautions must be taken. However such precautions are not included in the MPEG protocol because it was fashioned primarily for noiseless transmission channels.

[0003] ADTV is a fully digital simulcast system that delivers high definition television (HDTV) in a single 6-MHz broadcast channel. It is currently being developed by the Advanced Television Research Consortium (ATRC). One of the primary design goals of ADTV is to deliver high-quality and robust digital HDTV service for terrestrial simulcast transmission. The ADTV system uses MPEG compression to permit transmission of HDTV signals within a 6-Mhz channel. However the ATRC has augmented MPEG by adding a custom higher layer structure (MPEG++Rev 1) to achieve sufficient signal robustness for transmission over noisy terrestrial transmission media. This augmentation includes the prioritization of MPEG data into a two tier high-priority (HP), low priority (LP) transmission scheme, and includes a transport protocol to support multiple data services, and to provide graceful degradation in receiver performance in the presence of transmission errors.

[0004] DirecTV is a fully digital system that delivers standard definition NTSC television to the home over a satellite channel. It is currently being developed by Thomson Consumer Electronics (TCE). It is similar to ADTV in that it uses MPEG data compression but it is not HDTV. This is a one tier system for transmitting NTSC quality television signals.

[0005] US-A-5 122 875 discloses MPEG transmission in a noisy environment, parsing the data into high and low priority data and forward error correction.

[0006] US-A-4 398 290 discloses inserting a continuity index into the prefix of a packet to detect loss of packets in the receiver.

[0007] The present invention involves a transport protocol for arranging hierarchically formatted compressed video data for robust transmission in noisy communication channels and apparatus for realizing the transport protocol. The transport protocol presented here defines cells (or packets) of data where each cell includes a Prefix and a Transport Block. In an exemplary embodiment, the Prefix consists of four bits of control information and twelve bits for service channel identification. The Transport Blocks, (typically 128 bytes) consists of either Auxiliary data, Redundant MPEG Headers, or standard MPEG data. Compressed video data is applied to a transport processor which is responsive to the header data to develop transport block headers, and to store particular header data. The transport processor segments the compressed data into data blocks of predetermined size and appends transport headers thereto to form cells for transmission. The particular stored header data is formatted into a plurality of cells and these cells are interspersed between regularly occurring successive cells of compressed data.